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AMENDMENTS TO THE CLAIMS

Please cancel Claims 1-75.

Please add new Claims 76-117 as indicated below.

1-75. (Cancelled)

76. (New) A substrate processing system comprising:

a source of a carrier gas;

a support medium having a surface onto which a solid source for vapor reactant is coated, the support medium being configured to guide the carrier gas through the support medium and to facilitate saturation of the carrier gas, the coated support medium collectively forming a bed, the source of carrier gas being connected upstream of the support medium; and

an atomic layer deposition (ALD) chamber connected downstream of the support medium.

77. (New) The system according to Claim 76, wherein the support medium is configured to remain substantially stationary during the saturation of the carrier gas.

78. (New) The system according to Claim 76, wherein the support medium is configured to guide the carrier gas in a convoluted contact path.

79. (New) The system according to Claim 76, further comprising a pulsing mechanism configured to provide pulses of saturated carrier gas from the support medium to the atomic layer deposition (ALD) chamber.

80. (New) The system according to Claim 79, wherein the support medium is further configured to facilitate repeated saturation of the carrier gas with the vapor reactant for greater than 100,000 pulses, each pulse lasting for about 0.1-10 seconds.

81. (New) The system according to Claim 76, further including a sublimation vessel, located downstream of the carrier gas source and upstream of the reaction chamber, the support medium being located in the vessel, the solid source coating having a ratio of total exposed surface area to bed volume greater than about 0.1 cm^{-1}.

82. (New) The system according to Claim 76, wherein the bed is formed from a plurality of packed flowable support elements.

83. (New) The system according to Claim 76, wherein the support medium has a shape selected from a group consisting of beads, rings, cylinders, and filaments.

84. (New) The system according to Claim 76, wherein the solid source coating has a ratio of total exposed surface area to bed volume greater than about 1 cm^{-1}.

85. (New) The system according to Claim 76, further comprising a heat source capable of increasing the vaporization of the solid source for vapor reactant.

86. (New) The system according to Claim 76, further comprising a vessel containing the support medium, the system being configured to pulse a substantially plug flow residence time distribution of both the carrier gas and the vapor reactant through the vessel.

87. (New) A sublimation apparatus comprising:

a sublimation vessel;

an inlet port leading into the vessel;

an outlet port leading out of the vessel;

a solid source for vapor reactant contained within the vessel; and

a support medium having a coating of a solid source for vapor reactant, the coating having a ratio of exposed surface area to support medium volume greater than about 0.1 cm^{-1}.

88. (New) The apparatus according to Claim 87, wherein the solid source for vapor reactant coating is hafnium chloride ($HfCl_4$).

89. (New) The apparatus according to Claim 87, wherein the solid source for vapor reactant coating is zirconium chloride ($ZrCl_4$).

90. (New) The apparatus according to Claim 87, configured to draw the vapor reactant through the support medium and out of the outlet port via convective transfer.

91. (New) The apparatus according to Claim 87, configured to guide a carrier gas through the support medium.

92. (New) The apparatus according to Claim 87, further including a manifold located in the sublimation vessel, the manifold being configured to distribute a carrier gas across the vessel to contact the coated support medium.

93. (New) The apparatus according to Claim 87, wherein the sublimation vessel is configured to have the inlet port and the outlet port located at opposite ends of the vessel.

94. (New) The apparatus according to Claim 93, wherein the sublimation vessel is a cylinder.

95. (New) The apparatus according to Claim 87, wherein the support medium is formed from flowable support elements packed into the vessel.

96. (New) The apparatus according to Claim 95, wherein the support elements have shapes selected from a group consisting of beads, cylinders, filaments and rings.

97. (New) The apparatus according to Claim 87, wherein the support medium coated with solid source for vapor reactant is selected from the group consisting of a tube, a coiled tube, a bundle of tubes, a filter, and a multiple intersecting plate structure.

98. (New) The apparatus according to Claim 97, wherein the support medium is configured to substantially conform to the shape of the sublimation vessel.

99. (New) The apparatus according to Claim 87, wherein the support medium is configured to guide the carrier gas through a generally tortuous contact path.

100. (New) The apparatus according to Claim 87, wherein the support medium is a substantially inert, thermally conductive support medium.

101. (New) The apparatus according to Claim 100, wherein the support medium comprises a material selected from the group consisting of alumina (Al_2O_3), fused silica, stainless steel, hastelloy, nickel, silicon carbide (SiC), and boron nitride (BN).

102. (New) The apparatus according to Claim 87, further comprising a heat source capable of increasing the vaporization of the solid source for vapor reactant.

103. (New) A method of employing a vapor reactant for substrate processing comprising:

introducing a carrier gas into a vessel through an inlet port;

guiding the carrier gas to contact sufficient vapor reactant from a solid source material in order to repeatedly saturate the carrier gas with the vapor reactant, the saturation of the carrier gas continuing for greater than 100,000 pulses of carrier gas, each pulse lasting for greater than about 0.1 seconds; and

pulsing the carrier gas out of the vessel through an outlet port, wherein time between successive pulses is no more than about 30 seconds.

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104. (New) The method according to Claim 103, wherein guiding comprises flowing the carrier gas through a support medium coated with the solid source material.

105. (New) The method according to Claim 104, further comprising inserting the support media into a substantially stationary position within the sublimation vessel.

106. (New) The method according to Claim 103, wherein guiding the carrier gas comprises guiding the carrier gas in a generally helical contact path as defined by a flow guide.

107. (New) The method according to Claim 106, wherein the solid source material is in the form of a solid powder.

108. (New) The method according to Claim 106, wherein a plurality of stacked trays partially define levels of the helical contact path, the plurality of stacked trays being configured to ensure contact of the carrier gas with the vapor reactant along the helical contact path.

109. (New) The method according to Claim 103, further comprising channeling the carrier gas carrying the solid source vapor to a chemical vapor deposition (CVD) reactor.

110. (New) The method according to Claim 103, further comprising:

pulsing the carrier gas carrying the vapor reactant to an atomic layer deposition (ALD) reaction chamber;

removing any excess vapor reactant from the reaction chamber;

pulsing a second reactant into the reaction chamber; and

removing any excess second reactant from the reaction chamber.

111. (New) The method according to Claim 103, further comprising pouring a plurality of support elements through a fill port in the sublimation vessel, the support elements being coated with the solid source material.

112. (New) A sublimation apparatus for producing a vapor reactant for flowing through a reaction chamber, comprising:

a sublimation vessel;

a bed of solid source for the vapor reactant, the solid source bed contained within the vessel and in the form of a solid powder;

a carrier gas guidance structure with which the solid source is directly in contact, the guidance structure configured to guide the carrier gas to contact the vapor reactant by providing a substantially helical pathway for the carrier gas;

a vessel inlet port located at the beginning of a unitary contact pathway provided by the carrier gas guidance structure; and

a vessel outlet port located at the end of the unitary contact pathway provided by the carrier gas guidance structure, wherein the carrier gas guidance structure is configured to ensure contact of the carrier gas with the vapor reactant along the substantially helical pathway having a length greater than about 2.5 times a linear distance measured from the inlet port to the outlet port.

113. (New) The sublimation apparatus according to Claim 112, wherein the guidance structure is a flow guide configured to extend from a sublimation vessel floor to a sublimation vessel ceiling.

114. (New) The sublimation apparatus according to Claim 112, wherein the guidance structure comprises a plurality of levels within the vessel with each level containing a batch of the solid source for vapor reactant.

115. (New) The sublimation apparatus according to Claim 112, wherein the guidance structure comprises a plurality of stacked trays partially defining levels of the helical pathway.

116. (New) The sublimation apparatus according to Claim 115, wherein at least one of the plurality of stacked trays is a guided tray comprising at least one substantially circular pathway, the guided tray being configured to guide the carrier gas at least one lap of at least about 200° around the guided tray before channeling the carrier gas to an adjacent tray.

117. (New) The sublimation apparatus according to Claim 115, wherein at least one of the plurality of stacked trays is a guided tray comprising a secondary partial divider which partially defines at least two substantially circular pathways in the guided tray, the secondary partial divider in combination with tray sidewalls being configured to guide the carrier gas about two laps around the guided tray before channeling the carrier gas to an adjacent stacked tray, each lap being at least about 200° around the guided tray.